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MINERALOGICAL NOTES: No. IV.—ORTHOCLASE IN NEW SOUTH WALES

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(Plates xlviii.-lii.).

Macroscopic crystals of felspar are of common occurrence in the granitic area of Northern New South Wales and have been noted by various observers, but so far no crystallographic description has appeared. It is proposed in this paper to describe and illustrate some of the more interesting orthoclase crystals comprised in the Australian Museum collection, plagioclase felspars being reserved for a subsequent article.

The specimens figured were with one exception acquired by the Trustees from Mr. D. A. Porter, of Tamworth, to whom also I am under obligation for particulars of their finding and mode of occurrence. Mr. E. C. Andrews, of the Geological Survey of New South Wales, who possesses an extensive knowledge of the granites of New England, has been good enough to examine the collection, and has given me valuable information regarding the field relations of the rocks in which the felspars are found.

For identification purposes Becke's method was employed; by the use of a liquid with a refractive index greater than those of orthoclase and about equal to the mean index of albite, orthoclase was easily distinguished from plagioclase. This method was supplemented by observation of the extinction angles on cleavage flakes. The crystal forms were determined by inspection corroborated by measurement with a contact goniometer.

Cockburn Creek.

(Plate xlviii., fig. 1).

A single specimen from "Beadle's Conditional Purchase," Cockburn Creek, near Tamworth, is in the Museum collection. It consists of an aggregate of glassy crystals of a typical adularia habit, accompanied by small brownish crystals of axinite. The felspar presents the simple combination *c* (001), *m* (110), *x* ($\bar{1}01$), *c* and *x* having a tendency to oscillate with one another and give a somewhat rounded termination.

For chemical analysis some fragments were broken off, and, after examination with a hand lens and removal of a slight iron stain by hot hydrochloric acid, ground to fine powder. For general analysis ·3241 gram was taken, for alkalies ·4962 gram. The alkalies were determined by Lawrence Smith's well-known method, the amount of alkali in the calcium carbonate employed being determined and allowed for. The filtrate from alumina gave no precipitate with ammonium oxalate on prolonged standing, hence lime, if present at all, must be in very small amount; other components possibly present in traces, as oxide of iron, magnesia, and water, were not specially searched for in view of the small quantity of material available. Further, the percentage of silica is slightly low and of alumina rather high, perhaps owing to the contamination of alumina by traces of silica not removed in the first operation.

The appended analysis I. shows that the mineral is a nearly pure potash felspar; II. is Tschermak's analysis of adularia from Pfitsch,[1] while III. is the theoretical percentages for $KAlSi_3O_8$.

	I.	II.	III.
SiO_2	63·90 %	64·5 %	64·7 %
Al_2O_3 ...	20·61	18·4	18·4
Ca O		·3	
Na_2O... ...	·37	1·3	
K_2O	15·39	14·8	16·9
	100·27	99·3	100·0

OBAN.

(Plate xlviii., figs. 2, 3, 4; Pl. xlix., figs. 1, 2; Pls. l.-lii.).

In our collection there is a fine suite of felspar crystals, some of large size, from this locality, a notable feature being the excellent development of Baveno twins. This occurrence has been noted by Porter when describing quartz from Oban,[2] and he

[1] Tschermak—Ber. Ak. Wien, l., (1), 1865, p. 577 (quoted Dana—Syst. Min., 6th edit., 1892, p. 319).

[2] Porter—Journ. Roy. Soc. N. S. Wales, xviii., 1884 (1885), p. 75.

has recently given me additional information regarding the locality. The best specimens in the collection were obtained some thirty-five years ago by the late Mr. Thomas Clarke of Oban while blasting up a side channel in the granite in order to divert the stream from the bed of Oban Creek and facilitate the search for gold and tin-ore therein. Detached crystals of felspar, accompanied by tourmaline, topaz, cassiterite and gold are sometimes found in the alluvial wash in the neighbourhood of Oban.

The granite of Oban belongs to the "later and more acid type" of Andrews[3]; associated with it is a series of eurites, often pegmatitic, and it is mainly, if not entirely, from the pegmatite phases that the large crystals of orthoclase here described have come. A common characteristic in hand specimens is a graphic intergrowth of quartz and felspar; this is seen on a large scale in the specimen shown in Pl. l., fig. 1, where the several quartz crystals project from the felspar with their vertical axes parallel. One interesting specimen consists of a group of large crystals of smoky quartz, the core of one being an elongated crystal of felspar twinned on the Baveno law but without terminations. A somewhat similar association is seen in Pl. li., where a well-developed Baveno twin is partly embedded in a smoky quartz crystal. Besides quartz (usually smoky), which is a constant companion of the orthoclase, we find associated with it, tourmaline, in the usual striated columnar crystals, and a plagioclase felspar, which, from refractive index and extinction angles, is found to be near albite. Plate lii., is a photograph of a slab consisting of large, buff, orthoclase crystals, much decomposed, seated on which are fresher, whitish crystals of albite in intercrossing pericline twins. A fine example of a Baveno doublet is shown in Pl. xlviii., fig. 2; it has the usual habit elongated parallel to the axis [*c*, *b*]. The two portions are not quite symmetrical to the combination plane, the face c' (001) slightly overlapping the face *b* (010), with which it is practically coplanar, but the boundaries of the two segments are easily traceable by the aid of the series of more or less parallel markings present on every face and having a direction on each approximately parallel to the intersection of the particular face with the plane of the pinacoid (100). These lines of corrosion are somewhat less pronounced on the prism *m* (110), which still retains a dimly vitreous lustre. This crystal measures about 4 × 2 cm.

A more complicated twin is represented in Pl. xlviii., fig. 3. It may be interpreted either as a triplet according to the Baveno

[3] Andrews—Rec. Geol. Survey N. S. Wales, viii., 2, 1905, p. 116.

law, or the segment on the left of the figure with faces labelled $\bar{b}$, $\bar{c}$, $\bar{o}$, $\bar{x}$, may be regarded as twinned to the segment in the normal position on the Manebach law; it is not possible without very exact measurement to decide between these alternatives. This specimen, like the last, is much corroded in approximately parallel lines and it shows here and there small scales of a yellowish micaceous mineral. It measures about 9 × 3·5 cm.

Another isolated Baveno doublet (Pl. xlix., fig. 1) exhibits an irregular junction of the two segments, that on the left partially enveloping the other. This crystal, which is drawn with the edge [b, c] perpendicular to the plane of the paper, measures 3·5 × 1·25 cm.

An interesting crystal of which the exact locality is not known is similarly drawn in Pl. xlix., fig. 2. It was acquired in a collection of Australian and New Caledonian minerals from Mr. A. H. F. Stephens, who gave the locality as New South Wales. It bears a close resemblance to the Oban twins, and, like them, is accompanied by yellowish mica scales; hence we may fairly assume that it was derived from the granite of Oban or the neighbourhood. Like the specimen described above (Pl. xlviii., fig. 3), it may be regarded either as a Baveno triplet or as a combined Baveno and Manebach group. The junctions are remarkably regular and the crystal as a whole is well balanced; it is, though not the largest, perhaps the finest example of a Baveno twin in the collection of New South Wales orthoclase. It measures 4·5 × 1 cm.

While the Baveno twins are the finest, crystals also twinned according to the other well established laws, the Carlsbad and Manebach, are forthcoming from Oban. Of the former the crystal represented in Pl. xlviii., fig. 4, may be taken as typical. It shows the forms c (001), b (010), a (100), m (110), z (130), x ($\bar{1}01$), y ($\bar{2}01$), o ($\bar{1}11$); of these the pinacoid a is of infrequent occurence on orthoclase. The m faces are comparatively bright (it seems as if these resist corrosion with greater success than do the other faces). The terminal faces are marked by irregular branching lines with a general direction parallel to the edge [c, a]; these markings are of very usual occurence on orthoclase crystals, and, as they are accentuated on worn crystals, are probably due to corrosion. The b pinacoid is finely striated parallel to the intersecting edges of the prismatic zone. The faces c and x are represented in the figure as coplanar; strictly speaking c (ρ = 26° 3′) is somewhat steeper than x (ρ = 24° 13′);

in Pl. xlix., fig. 4, the difference is slightly exaggerated to show that the faces are not quite in one plane. Well-defined cracks parallel to the basal pinacoid traverse the faces in the prism zone; by observing the direction of these cleavage cracks one can easily distinguish c from x, even when these are to all appearance coplanar and physically similar, and the dome y is not present. This crystal, which measures approximately 2 × 1·5 × 1 cm., forms one of a small group of felspar and smoky quartz crystals with a crumbly pegmatitic matrix. Seated in parallel position on, and partially embedded in, the figured crystal are small crystals of albite.

Manebach twins are not met with so frequently as Baveno and Carlsbad types. One good but rather decomposed example, accompanied by orthoclase in Baveno and Carlsbad twins, albite and smoky quartz was observed; in habit and development it is essentially similar to the crystal figured in Pl. xlviii., fig. 5, which comes however from Bolivia. In the Oban crystal albite is in parallel position with the two segments of the Manebach twin; hence the albite also must be twinned on the Manebach law.

On the whole the orthoclase crystals of Oban suggest a comparison with those described from Four-la-Brouque, France.[4]

Uralla.

(Plate xlix., fig. 5).

In the Museum collection are a few specimens of orthoclase from the Rocky River, Uralla, which are in general very similar to the Oban mineral. This similarity is no doubt due to their having been derived from a geologically equivalent pegmatite. All the Rocky River felspars, Mr. Porter informs me, were obtained in the alluvial gold wash, where they are accompanied by ilmenite, zircon, quartz and jasper. It is worthy of note that no tourmaline or cassiterite is found in the Rocky River wash, in which it differs from the alluvial drifts in the neighbourhood of Oban.

A Carlsbad twin from the Rocky River is interesting as an example of what is sometimes described as a left-handed twin, as distinguished from the other figured crystals (Pl. xlviii., figs. 4, 6 and Pl. xlix., fig. 4) which are right-handed. This is a comparatively small crystal, measuring about 1 × ·8 × ·5

[4] Gonnard—Bull. Soc. Fr. Min. vi., 1883, p. 265; *Ibid.*, viii., 1885, p. 307; *Ibid.*, xi. 1888, p. 177.

cm. It is associated in the hand specimen with crystals of smoky and ordinary quartz, albite in Carlsbad twins, and small scales of black mica, the last where the idiomorphic felspar and quartz become merged into a fine-grained granite. The basal plane is fairly bright, while *x* is corroded and quite devoid of lustre, the distinction between the two being obvious at a glance.

Another specimen from this locality is in all respects similar to the (much larger) group from Oban figured in Pl. lii. The similarity is so pronounced that one would almost be inclined to regard them as fragments from one and the same block.

Bolivia.

(Plate xlviii., fig. 5 ; Pl. xlix,, figs. 3, 4).

Just as the prevalence of Baveno twins marks the Oban orthoclase, so the special feature of the Bolivia occurrence, so far as represented in the collection, is the excellence of the Carlsbad twins. The crystals are in general fresher than those from Oban and Uralla, this being perhaps due to their being obtained from druses in the "acid" granite, not from pegmatite veins and lenses.

In Pl. xlix., fig. 3 is shown a group consisting of three Carlsbad twins and a Manebach twin, accompanied by three crystals of slightly smoky quartz ; the same Manebach twin is partially idealised in Pl. xlviii., fig. 5. Another fine crystal twinned on the Carlsbad law (Pl. xlix., fig. 4) is one of a group of four, and measures about 3 × 2 × 1 cm. The prism faces are smooth and bright, the terminal faces and the *b* pinacoid slightly striated parallel to their intersection with the plane of the *a* pinacoid.

Inverell.

(Plate xlviii., fig. 6).

From a decomposed felspar-porphyry about fourteen to twenty miles north-east from Inverell good examples of Carlsbad twins are obtained, one of which is drawn and partly idealised. The crystals are quite different in appearance from those described above from other localities in the State, as, instead of being white or buff in colour, they are brick-red. The figured crystal measures about 2 × 2 × 1 cm.

That I am able to present a plate of shaded drawings is largely owing to the instructions and hints of my colleague, Mr. A. R. McCulloch, to whom my best thanks are due.

EXPLANATION OF PLATE XLVIII.

ORTHOCLASE.

In this and succeeding plates segments in twin position are lettered to correspond with a normally placed crystal turned through 180°.

Fig. 1. Adularia habit. Cockburn Creek, near Tamworth.

„ 2. Baveno doublet. Oban.

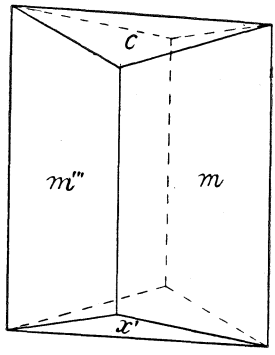
„ 3. Baveno triplet or (as lettered) combined Baveno and Manebach twin. Oban.

„ 4. Carlsbad twin. Oban.

„ 5. Manebach twin. Bolivia.

„ 6. Carlsbad twin. Inverell.

Forms :—*c* (001), *a* (100), *b* (010), *m* (110), *l* (130), *x* ($\bar{1}01$), *y* ($\bar{2}01$), *n* (021), *o* ($\bar{1}11$).



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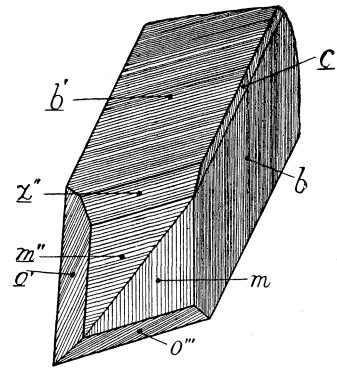

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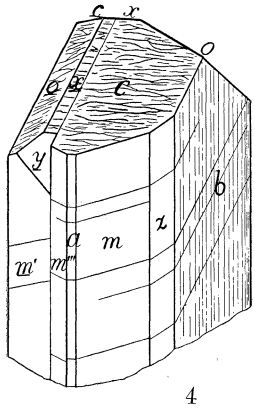

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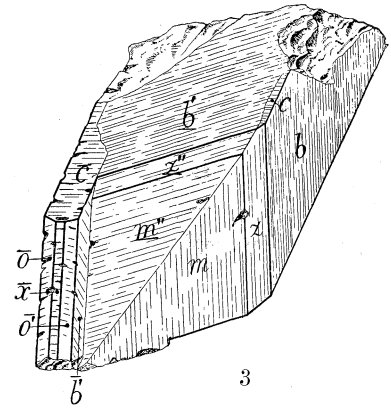

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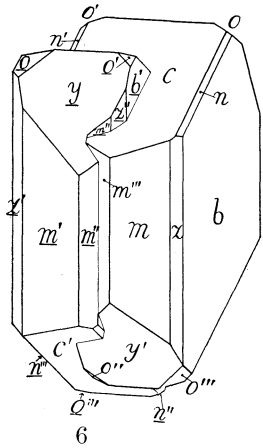

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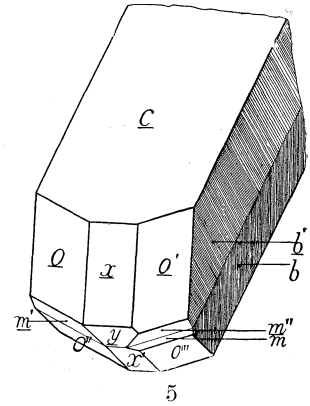

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EXPLANATION OF PLATE XLIX.

ORTHOCLASE.

Fig. 1. Baveno twin. Oban.

Fig. 2. Baveno triplet or combined Baveno and Manebach twin. Oban (?).

Figs. 1 and 2, which are about four times natural size, are bounded by the faces *c* and *b*, which are placed perpendicular to the plane of the paper.

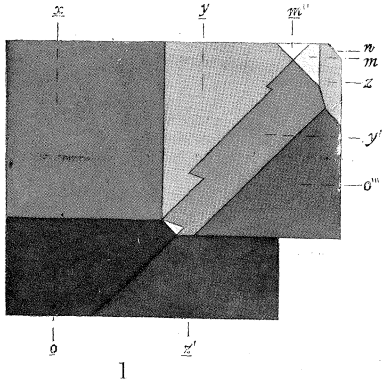
Fig. 3. Group of orthoclase and quartz crystals, about twice natural size; the largest Carlsbad twin consists of the forms *c*, *b*, *m*, *x*, *o*; the Manebach twin is separately drawn in Pl. xlviii., fig. 5. Bolivia.

Fig. 4. Right-handed Carlsbad twin; about twice natural size. Bolivia.

Fig. 5. Left-handed Carlsbad twin; about four times natural size. Uralla.

Figs. 4 and 5 have the forms *c*, *b*, *m*, *x*, *y*, *o*.

(For indices see Explanation to Plate xlviii).



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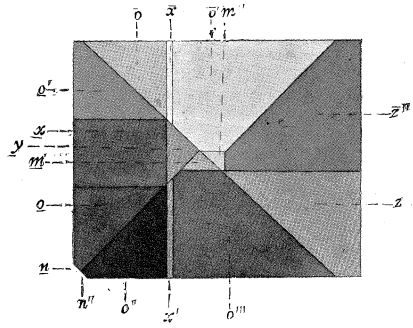

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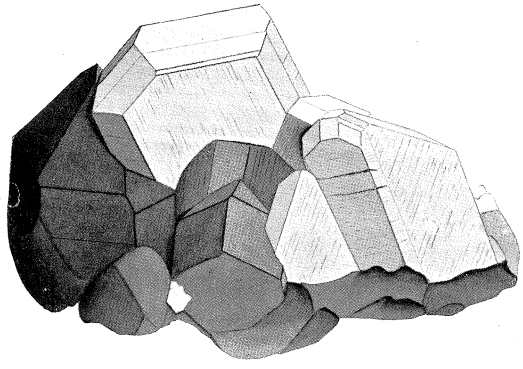

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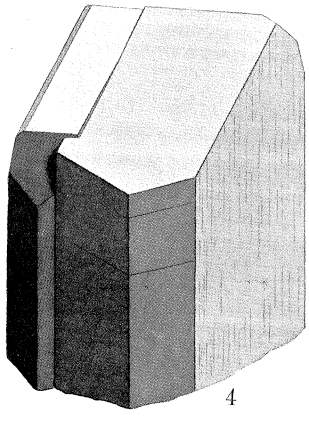

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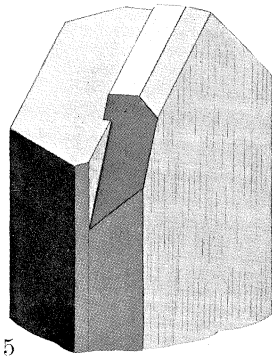

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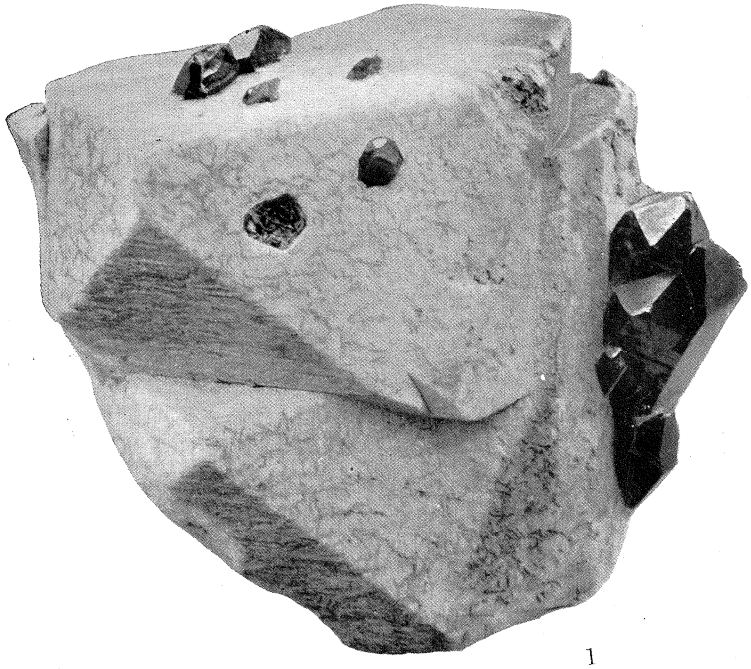
Austr. Mus.

EXPLANATION OF PLATE L.

ORTHOCLASE.

Fig, 1. Two "partial" crystals with *c*, *b*, *m*, *x*, *y*, penetrated by quartz with principal axes parallel to one direction; slightly enlarged. Oban.

Fig. 2. Baveno group; natural size. Oban.



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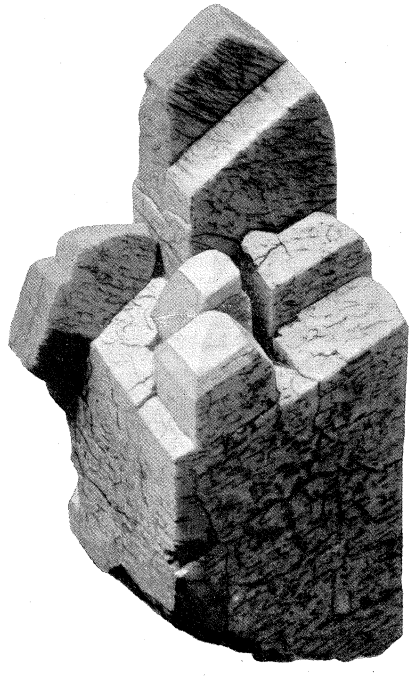


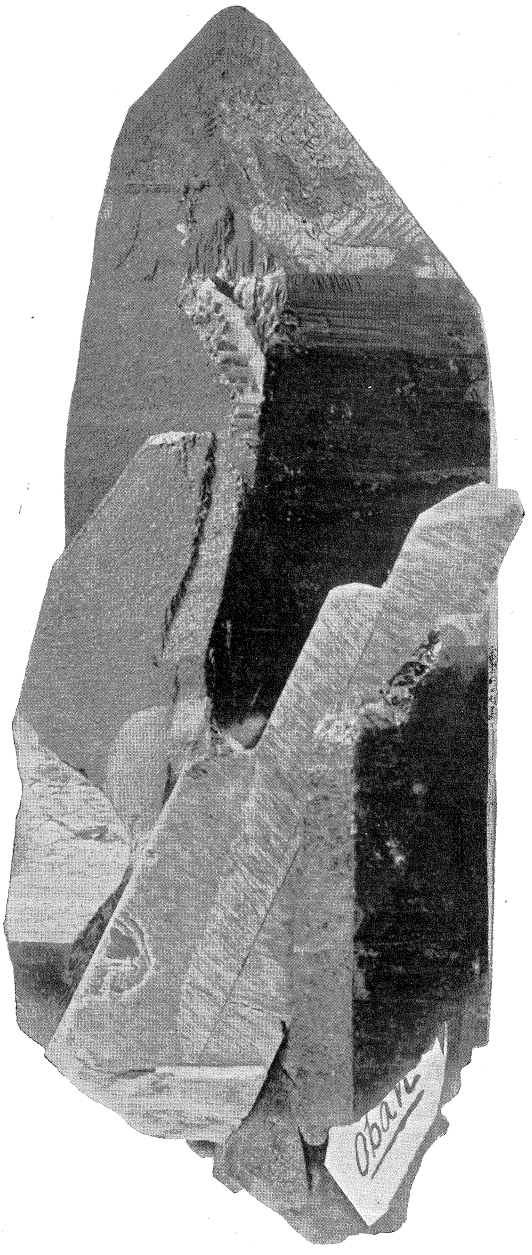
2

H. BARNES, Junr., photo.
Austr. Mus.

EXPLANATION OF PLATE LI.

ORTHOCLASE.

Crystal of smoky quartz penetrated by Baveno twin; natural size. Oban.



H. BARNES, Junr., photo.
Austr. Mus.

EXPLANATION OF PLATE LII.

ORTHOCLASE.

Decomposed crystals carrying pericline twins of albite; natural size.
Oban.

H. BARNES, Junr., photo.
Austr. Mus.